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Locating coherent material vortices in three-dimensional unsteady flows DAVID OETTINGER, DANIEL BLAZEVSKI, GEORGE HALLER[1], ETH Zurich — Recent work has shown that coherent material vortices in two-dimensional unsteady flows are bounded by closed stationary curves of the averaged material strain [1]. These material vortex boundaries are objective (frame-invariant) Lagrangian coherent structures (LCSs) of the elliptic type, which turn out to stretch uniformly under the flow. We extend this approach to three-dimensional unsteady flows to locate toroidal and cylindrical material vortex boundaries as two-dimensional, elliptic LCS surfaces. We provide a detailed numerical procedure building on the approach in [2] and discuss several examples.

[1] G. Haller and F.J. Beron-Vera, Coherent Lagrangian vortices: The black holes of turbulence. J. Fluid Mech. 731 (2013) R4
[2] D. Blazevski and G.Haller, Hyperbolic and elliptic transport barriers in three-dimensional unsteady flows, Physica D, 273–274 (2014), 46-62.

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